IES

Newsletter

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Director's Note

On November 24 it was my pleasure to meet and congratulate recent graduates of the Institute's Continuing Education Program. These landscape design and gardening students worked hard for two or more years to fulfill program requirements. Many will use these new skills to advance in their present occupations. Others will open their own businesses. Some will apply what they have learned to a home landscape or garden, while a number may pursue a degree in landscape architecture, horticulture or botany.

One of the goals of this IES program is to promote an ecological approach to landscape design, gardening, land management and environmental policy making. We are proud that our students benefit from — and promote — this ecological perspective.

(*An article about the recent certificate ceremony is on page 3.*)

The IES Newsletter is published by the Institute of Ecosystem Studies at the Mary Flagler Cary Arboretum. Located in Millbrook, New York, the Institute is a division of The New York Botanical Garden. All newsletter correspondence should be addressed to the editor.

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In Ecosystems, Tiny Diatoms Have Important Roles

Hummingbirds ... a monarch's chrysalis ...
orchids ... peacock feathers ...
tropical tree frogs ... a pearl ... diatoms ...

Diatoms? In a list of some of Earth's natural jewels, why are these microscopic water plants included? And, what do they contribute to Earth's ecosystems?

* * * * *

Diatoms are invisible to the naked eye: laid end-to-end, 1,000 of them would make a line only 25 millimeters (1 inch) long. Like most other plants, these single-celled and colonial algae use chlorophyll for photosynthesis*, but the green is masked by golden-brown pigments that give diatoms their color. Their cell walls are made of silica, and it is these decorated, geometrical, glasslike skeletons that put them at the top of the list of nature's jewels.

With 30,000 different species, there are more kinds of diatoms than of any other kind of alga. They are abundant in oceans as well as in freshwater bodies, and while many species are free-floating, others attach themselves to rocks and underwater debris. Diatoms are often at the base of marine and aquatic (fresh water) food webs and also are major oxygen producers. Oxygen is released during photosynthesis, and, with millions of diatoms per liter (approximately a quart) of sea water, it is not surprising that experts believe that from 50 to 75% of the world's oxygen is produced by these tiny plants.

Diatoms also are excellent indicators of environmental quality. In any marine or aquatic habitat there are 20 to 100 or more different species that are easily recognizable under a microscope. Since each species reacts to pollutants in different ways, the relative abundance of species that differ in resistance or sensitivity to different pollutants forms the basis of standard keys for determining environmental quality. Because the glass cell walls of diatoms are preserved in sediments, the same keys can be used to document the history of pollution in areas where diatom skeletons have been deposited.

Dr. R. Jan Stevenson, on a year's sabbatical at the Institute of Ecosystem Studies from his position at the University of Louisville in Kentucky, has designed a series of studies that will improve the use of diatoms as environmental indicators. The purpose of these experiments is to learn more about the impacts on streams of excess nutrients from agriculture, e.g., fertilizers, and to do this task he is making comparisons between diatom populations in clean streams and in those that receive runoff from farmland. He is not, however, doing all his research in natural streams. To enable him to control the variables relevant to his research — light, current and nutrient levels — he has

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TOM TAFT

Dr. Stevenson with an artificial stream along the East Branch of Wappinger Creek. Water is recirculated from one end of the Plexiglas channel to the other by a propeller at the downstream end of the channel. Diatoms use the rocks in the channel as substrate for attachment.

** Photosynthesis is a chemical reaction in the chlorophyll-containing cells of plants, in which water and carbon dioxide are converted to carbohydrates in the presence of sunlight.*

Diatoms, *from page 1*

built a small experimental stream facility at the Institute.

Dr. Stevenson's artificial streams are Plexiglas channels, eight in all, each 1.2 meters (4 feet) long and 10 centimeters (4 inches) wide. Before the experiments began, Dr. Stevenson put ceramic tiles in the East Branch of Wappinger Creek, which winds through the Arboretum, and left them there for a week, allowing natural colonization by diatoms. He also collected water from the creek. During the experiments, he arranges colonized tiles in the channels, then recirculates water from the creek through the channels, back through pipes, through the channels again and so on for four-day periods. There are no data on the rate of diatom transport within streams, so at the mouth of each channel a fine-mesh screen traps detached diatoms, enabling an assessment of the numbers of diatoms that grow in one place but are transported to another. Such transport is important for the many aquatic animals that eat diatoms by filtering them from the water or by gathering those that settle onto substrates in their feeding range.

The artificial streams receive three "treatments". During the course of each four-day run, light, stream current and nutrients (nitrate and phosphate, present in agricultural run-off) are adjusted to see how each affects the attachment, growth and detachment of diatoms. Because eight channels are built into the system, there are replicates of each treatment to double-check the data. Experiments will continue through February and March, and will include studies of stream bacteria in collaboration with IES aquatic ecologist Dr. Stuart E.G. Findlay.

In a separate investigation planned for late winter and spring, Dr. Stevenson will do a study along an urban-to-rural gradient*. Visiting 30 streams along the gradient, as well as in New York's Catskill Mountains and the White Mountains of New Hampshire, he will collect diatoms by scraping rocks and taking water samples. Then, knowing that some diatoms are indicators of pollutants, he will determine the species composition and infer levels of pollution caused by metals and nutrients that leach into the streams from surrounding forest soils.

A diatom, Navicula gregaria, *(actual size: 25 μm, or 1/1000 in.) photographed through a transmission electron microscope. An image of the glass cell wall is shown: the regularly arranged oval markings are openings for passage of nutrients and wastes, and the long slit enables this species to attach and move across surfaces. The photomicrograph is by Rich Schultz, a graduate student of Dr. Stevenson's at the University of Louisville.*

Related research by Dr. Stevenson

Dr. Stevenson is an associate professor of biology at the University of Louisville. An aquatic ecologist, most of his research is done on streams, and — not surprisingly — his area of expertise is diatoms. For the past 10 years he has done field work at Bernheim Forest, a nature preserve not far from Louisville, where he monitors stream ecosystems — algae, invertebrate animals, fish, nutrient concentrations and so forth. He developed an experimental stream facility there to test the hypotheses that grew from his observations. In that facility, somewhat larger than the one he is using here, he pumps stream water through three meter long (10 feet) artificial stream channels made from ordinary vinyl gutters and containing tiles pre-colonized by diatoms.

One of his research interests is the effects of storms on stream life. Contrary to observations that most rainstorms cause flooding that scours many algae and animals from the stream, Dr. Stevenson observed that moderate rains had positive effects on diatoms attached to the stream bottom. These effects could be caused by two factors that occur during flood conditions: high nutrient concentrations in runoff from surrounding fields, and/or fast currents that can stimulate algal growth by rinsing away wastes that accumulate around cells. Dr. Stevenson developed an experiment in the artificial streams in which he could manipulate current and nutrient concentrations separately to determine which factor stimulated diatoms during floods. He found that the positive effects could be caused when increases in nutrient concentrations and current velocity occurred together, but not just by increases in current velocity. These results help scientists understand why streams in urban and agricultural regions, both of which have high nutrient runoff during floods, have a high abundance of algae, and streams in forests usually have a low abundance.

Dr. Stevenson also is doing research in northern Michigan, where each summer he teaches a stream ecology course at the University of Michigan Biological Station, the world's largest inland biological station. He has built an experimental stream facility there, in which he manipulates the same variables as in his other artificial stream channels. In Michigan, however, the physical, chemical and biological conditions in streams are very different from streams in Kentucky, so Dr. Stevenson will compare results from the two sites to see how the ecosystems differ.

* * * * *

It is becoming increasingly evident that ecosystems with the same basic groups of organisms, but in different geographic locations, can respond very differently to environmental change. Dr. Stevenson's studies in Kentucky, Michigan and the Mid-Hudson Valley, New York will lead to a better understanding of how regional climatic and geological conditions can cause differences in otherwise similar ecosystems. Results of these studies — and of other long-term research — help to evaluate the health of ecosystems and the consequences of further pollution, and to determine strategies for dealing with ecosystem disturbance.

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* *One of the Institute's long-term research projects is the "Urban-to-Rural Gradient Ecosystem Studies". Its purpose is to learn about the effects of human-accelerated environmental changes by examining ecosystems along a gradient of decreasing human activity and impact, from urban to rural sites. Data are being collected on a routine basis in forests along a 140 kilometer (100 mile) transect from Bronx County, N.Y. through Westchester and Dutchess counties to Litchfield, Conn., providing baseline information against which future changes can be measured.*

Honorary Degree for Dr. Likens

In recognition of the scientific contributions of Institute of Ecosystem Studies' Director Dr. Gene E. Likens, the Universität für Bodenkultur Wien (Agricultural University of Vienna) awarded him an honorary doctorate degree. During his visit to Austria for the November 1992 ceremony, Dr. Likens spoke to a class of graduate students in the university's Forestry Department on his research in New Hampshire's Hubbard Brook Experimental Forest, and gave a public lecture on human-accelerated environmental change.

At right, Universität für Bodenkultur Praerector Dr. Leo März presents the degree to Dr. Likens. Next to Dr. Likens is Dr. Paul Stefanovits of Universität Gödöllö, Hungary, who also received an honorary degree.

Continuing Education Program Recognizes Graduates

Among the offerings of the Institute of Ecosystem Studies Continuing Education Program are programs leading to certificates in landscape design and gardening. On November 24, 1992, 28 students who recently completed their certificate requirements were honored at a ceremony in the Institute's Plant Science Building.

Head of Education Dr. Alan R. Berkowitz opened the evening's program by welcoming certificate recipients and their families, course instructors and other guests. Dr. Gene E. Likens, Institute director, then spoke briefly of work by IES scientists on issues of local and regional concern, highlighting on-going research on zebra mussels, Lyme disease, forestry, and the Hudson River, and described Institute demonstrations of interest to the certificate recipients, such as the controlled burn of the meadow garden near the Plant Science Building.

William S. Montgomery, program leader for continuing education, introduced the keynote speaker, Patricia M. O'Donnell, who is the founder and principal of LANDSCAPES, a landscape architecture, planning and historic preservation firm in Westport, Conn. Ms. O'Donnell, a nationally recognized leader in her field, presented an illustrated talk on ecological approaches to some of her local landscape design projects. Following her address, certificate recipients came forward to be recognized, and refreshments were served.

TOM TAFT

Certificate recipients posed for a photograph with guest speakers, instructors and program leaders. Left to right: [seated] *Sheryl Reifler, Erin Kennedy, Jayme Petrucelli, Margaret Reifeiss, Julieann Elder, Muriel Barajikian, Jane Starbala, Shirley Niznik;* [standing] *Jennifer Claiborne (Continuing Education Program assistant), Dr. Gene E. Likens, Stephanie Mauri (instructor), guest speaker Patricia M. O'Donnell, E. Barrie Kavasch (instructor), Dr. Alan R. Berkowitz, Kevin Malloy, Norbert Lazar (instructor), Dennis Bryers (instructor), Robert Sprague, Chester Sprague, William Montgomery*
Certificate recipients unable to attend the ceremony: *Jeanette Bagnasco-Cloyd, Dana Beisheim, Agnes Dempster, George DiGiacomo, Irene Dyet, Bonnie Fiero, Carolyn Gordon, Lydia Graves, Ellen Kallmeyer, Betty Madden, Melanie Melius, Judy Rockefeller, Maureen Stenger, Anne Strain-Wood, Marie Upton-Murphy, Suella Waller, Esther Williams*

Winter Calendar

CONTINUING EDUCATION PROGRAM

Among the **winter and spring semester** offerings are the following **workshops:**

- History of Hudson Valley Landscapes and Gardens
- Native Plants in Design
- Country Gardens in Harmony with Nature
- Summer Bloom in the Garden
- Pond and Lake Management and Restoration
- Implementing Integrated Pest Management in Landscapes and Nurseries

Free catalogues describing these workshops, winter and spring **courses** in landscape design, gardening, botany, nature illustration and nature photography, and seven **ecological excursions** are available from the Gifford House. Call the number below for information.

SUNDAY ECOLOGY PROGRAMS

Free public programs are held on the first and third Sunday of each month, except over holiday weekends. Programs begin at 2 p.m. at the Gifford House on Route 44A unless otherwise noted. Call (914) 677-5359 to confirm the day's topic.

Feb. 21: **Update on Zebra Mussels in the Hudson River**, a slide presentation by Dr. David Strayer
Mar. 7: **Gaia Theory: Wake-up Call for Humanity!**, a slide presentation by Dr. William Shaw
Mar. 21: **A Visit to the Bottom of the Ocean: Microbial Research Using the Submarine ALVIN**, a slide presentation by Dr. Jonathan J. Cole
Apr. 4: **An Origami "Springtime Ecosystem"**, an activity led by Jill Cadwallader
Apr. 18: **A Walk Up Teahouse Hill**, a walk led by Ana Ruesink

Sunday Ecology Programs, continued:

• *In case of inclement weather, call (914) 677-5358 after 1 p.m. to learn the status of the day's program. For outdoor programs, dress for the weather conditions, with sturdy waterproof shoes.*

IES SEMINARS

The Institute's program of **scientific seminars** features presentations by visiting scientists. Free seminars are held at the Plant Science Building on Fridays at 3:30 p.m.

Feb. 12: **Intra- and Inter-ecosystem Comparisons of Nitrogen Cycling Using Network Analysis**, Dr. B. Christian, East Carolina University, N,C.
Feb. 19: Topic: **Water relations in trees**, Dr. T. Dawson, Cornell Univ.
Feb. 26: **PCBs in Food Webs**, Dr. E. Bentzen, Trent Univ.
Mar. 5: **Untangling the Multiple Mechanisms Underlying Herbivore-Algal Interactions in Streams**, Dr. P. McCormick, Elizabethtown College, Pa.
Mar. 12: **Ecosystem Level Consequences of Ratio-dependent Predation**, Dr. L. Ginzburg, SUNY Stony Brook
Mar. 19: Topic: **Marine microbial ecology**, Dr. D. Kirchman, Univ. of Delaware
Mar. 26: **Ecological Controls on Climate**, Dr. B. Hayden, Univ. of Virginia
Apr. 2: **Land Margin Ecological Research in Waquoit Bay**, Dr. I. Valiela, Boston Univ. Marine Program, Woods Hole, Mass.
Apr. 16: **Causes and Consequences of Species Invasions: General Theory and Aquatic Case Studies**, Dr. D. Lodge, Univ. of Notre Dame
Apr. 23: **Individuality and Symbiosis**, Dr. L. Margulis, Univ. of Massachusetts at Amherst

Seminars, continued:

Apr. 30: **Integrating Ecological and Social Dimensions of Forest Ecosystem Management**, Dr. L. Tritton, Univ. of New Hampshire

GREENHOUSE

The IES greenhouse is a year-round tropical plant paradise as well as a site for controlled environmental research. The greenhouse is open during Arboretum hours. Admission is by free permit from the Gifford House.

GIFT SHOP

Senior Citizens Days: On Wednesdays, senior citizens receive a 10% discount (except sale items).

ARBORETUM HOURS
(Winter hours: October 1 - April 30; closed on public holidays)

Arboretum grounds are open Mon. - Sat., 9 a.m. - 4 p.m.; Sun. 1 - 4 p.m. Internal roads are closed when snow-covered or icy — call the number below for a report on trail conditions. The **Gift and Plant Shop** is open Tues. - Sat., 11 a.m. - 4 p.m. and Sun. 1 - 4 p.m.
(Closed weekdays from 1 - 1:30 p.m.)

• *All visitors must pick up a free permit at the Gifford House Visitor and Education Center on Route 44A for access to the Arboretum. Permits are available until 3:00 p.m. daily.*

MEMBERSHIP

Become a member of the Mary Flagler Cary Arboretum. Benefits include a member's rate for IES courses and excursions, a 10% discount on purchases from the Gift Shop and a free subscription to the IES NEWSLETTER. Individual membership is $30; family membership is $40. For information on memberships, contact Janice Claiborne at (914) 677-5343.

For more information, call (914) 677-5359 weekdays from 8:30 - 4:30.

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